REMARKS

This paper is responsive to the Final Office Action dated October 23, 2006, Decision on Appeal dated December 24, 2008 and further in response to the Notice of Abandonments of March 17, 2009, wherein claims 1-7, 9-15, 17-23, 25 and 26 were rejected. A Petition to Revive and a Request for Continued Examination is filed concurrently herewith. By this response, subject matter of claims 2, 10, 18 and 26 have been canceled and the subject matter of the stated claims have been incorporated in independent claims 1, 9, 17 and 25 respectively. Further, the Applicants have added three new claims 27, 28 and 29, however no fee should be due based on the canceled claims. In view of the amendments and remarks made herein, the Applicants believe that claims 1, 3-7, 9, 11-15, 17, 19-23, and 25-29 recite subject matter patentable over the cited art. Reconsideration and allowance of all pending claims are requested in view of the arguments summarized below. No new matter is added.

35 USC §103

In the Final Office Action dated October 23, 2006, claims 1, 9, 17 and 25 were rejected under 35 USC §103(a) as being unpatentable over Morgan et al., US Patent No. 6,229,870 (hereinafter "Morgan") and Casey et al., US Patent No. 5,175,754 (hereinafter "Casey"). Claims 2-5 and 10-13 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Morgan reference and Casey reference as applied to claims 1 and 9 above and further in view of Yamagishi et al. US Patent No. 5,383,231 (hereinafter "Yamagishi"). Claims 6, 7, 14 and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Morgan reference and Casey reference as applied to claims 2 and 10 above and further in view of Taguchi et al. US Patent No. 6,466,640 (hereinafter "Taguchi"). Claims 18-21 and 26 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Morgan reference and Casey reference and in view of Yamagishi. Claims 22 and 23 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Morgan reference, Casey reference and Yamagishi reference as applied to claim 18 above and further in view of Taguchi. Applicants respectfully traverse this rejection.

Legal Precedent and Guidelines

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). In establishing a *prima facie* case for obviousness, "the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long-

felt but unresolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." *KSR Int'l Co. v. Teleflex, Inc.,* 127 S. Ct. 1727, 1729 (2007) (quoting *Graham v. John Deere Co.,* 383 U.S. 1, 17-18 (1966). It is often necessary "to look to interrelated teachings of multiple patents, the effects of demands known to the design community or present in the market place; and the background knowledge possessed by a person having ordinary skill in the art." *Id.* This analysis should be made explicit. *Id.* (citing *In re Khan,* 441 F.3d 977, 988 (Fed. Cir. 2006)) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness").

Additionally, a claim having several elements is *not* proved obvious merely by demonstrating that each of its elements was known in the prior art. *Id.* In this regard, the Supreme Court recently reiterated that it is "important to identify a reason that would have prompted a person of ordinary skill in the relevant filed to combine the elements in the way the claimed new invention does...because inventions in most, if not all, instance rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *Id.* As such, the obviousness inquiry does not hinge on demonstrating that elements were known in the art. Rather, the obviousness inquiry focuses on whether the claimed subject matter would have been obvious to persons having ordinary skill in the art in view of the demands and practices of the design community at the time of filing of the application. *See id.*

When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.,* 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988). One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. *In re Fine,* 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). The Federal Circuit has warned that the Examiner must not, "fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher." *In re Dembiczak,* F.3d 994, 999, 50 U.S.P.Q.2d 52 (Fed. Cir. 1999) (quoting *W.L. Gore & Assoc., Inc. v. Garlock, Inc.,* 721 F.2d 1540, 1553, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1983)).

Deficiencies of the Rejection

Independent claims 1, 9, 17 and 25, in their currently amended state, recite in generic terms, *generating a set of interpolated projections by interpolating the projection data set using* <u>*phase information from* the projection data set</u> *or from a set of concurrently acquired phase data and apriori frequency content of the projection data set, wherein each interpolated projection characterizes the projection data set at a particular view location of the gantry and at a particular time; and reconstructing the set of interpolated projections to generate one or more images.* In pages 5, 6 and 8 of the Final Office Action dated October 23, 2006, the Examiner stated that Morgan and Casey references failed to disclose the cited claim elements. The Examiner depended on Yamagishi for disclosure of the cited claim element.

Applicants respectfully submit that the Examiner has not shown objective evidence of the requisite basis to modify or combine the cited references to reach the present claims. In the Final Office Action dated October 23, 2006, the Examiner referred to column 5, line 53 - column 6, line 30 and drawing elements 12 and 13 of Yamagishi and stated that:

> Yamagishi discloses a method for acquiring a CT image of a heart, comprising the steps of generating (13) a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data and frequency content of the projection data set (the projection data set are acquired at a frequency or time interval), wherein each interpolated projection characterizes the projection data set at a view location of the gantry and at a particular time; and reconstructing the set of interpolated projections to generate one or more images. Final Office Action dated October 23, 2006, pages 5, 6 and 8 (emphasis added).

The Examiner has imparted attributes from Yamagishi in order to arrive at its conclusion which are unfounded based on the cited art. Yamagashi actually states the following in Col. 5, lines 53 – Col. 6, line 30:

> A single piece of each relevant projection data among the acquired continuous X-ray projection data is previously stored as a peak (crest) value of an electrocardiogram measured at the same time instant where this projection data is acquired. That is to say, the electrocardiogram data, the continuous X-ray projection data, the translation speed data (lmm/sec) of the couch 4 and the continuous X-ray projecting time data (sec) are supplied from the system control unit 5 into this cardiac-beat converting table unit 14. Thereafter, for instance, central time instances within the cardiac expansion periods defined between the successive R-waves R1, R2, R3. . . Rn, of the cardiac beats are calculated, namely the cardiac beats are obtained at the same phase within the cardiac expansion periods as represented in FIG. 4, based upon the above-described various data, and thereafter the resultant temporal data are converted into coordinate values in a longitudinal direction of the couch 4 or patient 20 (i.e.,

positions of the couch 4). In one practical method, these central time instants within the respective cardiac expansion periods are previously obtained by processing the actual time intervals between the sucessive R-waves R1, R2, R3, . . . Rn.

As previously described, the temporal information contained in the electrocardiogram data is converted into the positional information about the couch 4 by utilizing a memory table 30 employed in the cardiac-beat converting table unit 14 (see FIG. 3). Finally, the resultant positional information on the couch 4, namely the slice position data are supplied via the system control unit 5 to the interpolation/reconstruction unit 13.

Subsequently, in the interpolation/reconstruction unit 13, X-ray tomographic image data are reconstructed by processing these X-ray projection image data in conjunction with the positional information about the couch 4 (namely, slice position data) obtained from the cardiac-beat converting table unit 14. Accordingly, desirable three-dimensional images such as surface images and MPR images can be produced without any image distortions by interpolating these X-ray tomographic image data, and will be displayed on the display unit 16 in the helical scanning type X-ray imaging system shown in FIG. 2.

As noted in Yamagishi, the data is obtained and the reconstruction processing occurs to produce the images. In contrast, claim 1 recites, inter alia;

rotating a distributed X-ray source and a detector array about a volume of interest, volume containing a heart having a cardiac cycle, wherein a rotational period of the distributed X-ray source comprises a length of time required for image reconstruction and is approximately a multiple of the cardiac cycle, wherein the distributed X-ray source comprises a plurality of addressable X-ray focal spots;
emitting X-rays from the distributed X-ray source;
acquiring a projection data set comprising a plurality of projections generated from the emitted X-rays at each view location of a gantry;
generating a set of interpolated projections by interpolating the projection data set using phase information from the projection data set or from a set of concurrently acquired phase data and apriori frequency content of the projection data set, wherein each interpolated projection characterizes the projection data at a particular view location of the gantry and at a particular time; and
reconstructing the set of interpolated projections to generate one or more images.

There are a number of features that are not described or otherwise suggested by Yamagishi alone or in combination with the other references. For example, there is nothing in Yamagishi that suggests that the X-ray source is designed to rotate with a rotational period that includes a length of time required for image reconstruction and is approximately a multiple of the cardiac cycle. Instead, Yamagishi post-processes the data without such regard to establishing the rotational period to the cardiac cycle.

In addition, claim 9 and 25 includes the feature wherein the addressable X-ray focal spots of the distributed X-ray source are activated so that one or more view locations relative to the heart is substantially identical. Claim 17 includes the feature of a scan path <u>providing</u> <u>multiple projection data sets scanned over an angular coverage of the gantry less than 360</u> <u>degrees</u>.

Furthermore, the Examiner referred to column 2, lines 30-36 of Yamagishi and stated that Yamagishi taught this method is capable of obtaining a three-dimensional image of a heart without motion artifacts.

Therefore, the Examiner suggests combining the cited references based on the *conclusory and subjective statement* that "it would have been obvious to a person of ordinary skill in the art at the time the invention was made to generate a set of interpolated projections by interpolating the projection data set using a set of concurrently acquired phase data and frequency content of the projection data set, wherein each interpolated projection characterizes the projection data set at a view location of the gantry and at a particular time; and reconstructing the set of interpolated projections to generate one or more images since a person would be motivated to obtain a three-dimensional image of a heart without motion artifacts for diagnosis." *Id.*

In addition, with respect to Taguchi reference, the Examiner referred to column 5, lines 4-34 of Taguchi and stated that Morgan, Casey and Yamagishi failed to teach that the step of interpolating the projection data set comprises reducing statistical noise in the projection data set and Taguchi discloses a method of interpolating the projection data set that reduces statistical noise in the projection data set. Taguchi actually states the following in Col. 5, lines 4-34:

> As a further embodiment of the method according to the invention, it is also possible to reduce the patient dose. Some slice data sets are summed, average or weighted prior to helical interpolation (as described in the first part of the first embodiment). The slice positions are defined as the center of all slices. It can then be defined considering the weighting in the averaging process. For example, four-slice data may be averaged into two-slice data. In this case all of the data from the four slices are used in the helical interpolation which results in better image noise with some sacrifice of spatial resolution in the z direction. The patient dose may also be reduced by collimating the unnecessary x-ray beam for the outer slices before it reaches the patients, as shown in FIG. 26. A large helical pitch, TS, or longitudinal filtering requires data from outer slices. Otherwise, data from the outer slices are not used and represents unnecessary patient dose. Collimating the X-ray beam to exclude the outer slices thus making

it a dual-slice CT, can reduce the patient dose while not affecting image quality or scan time. This may result in two-slice helical CT in some cases.

A further method of reducing a patient dose is to use gated triggering of the multi-slice helical scanning. The EKG signal is stored during helical scanning, as described above. The EKG signal is used as a trigger for the x-ray exposure. After a defined amount of scanning, x-ray exposure is automatically stopped. This procedure repeats during "fake multi-slice helical scanning (continuous tube rotation and continuous bed movement with no x-ray exposure). Limiting only the range to be scanned (the diastolic phase) the patient dose may be reduced.

The Examiner further suggested combining the cited references based on the *conclusory and subjective statement* that "it would have been obvious to a person of ordinary skill in the art at the time the invention was made to reduce statistical noise during interpolation, since a person would be motivated to obtain an image without noise." *Id.* The Applicants referred to the cited passages as quoted above and state that in spite of the disclosure of a method of interpolating the projection data set that reduces statistical noise in the projection data set, there are a number of features that are not described or otherwise suggested by Taguchi alone or in combination with the other references. For example, there is nothing in Taguchi that suggests that the X-ray source is designed to rotate with a rotational period that includes a length of time required for image reconstruction and is approximately a multiple of the cardiac cycle. Instead, Taguchi merely relates to disclosure of a method of interpolating the projection data set that reduces statistical noise in the projection data set. Furthermore, Taguchi concedes that the dose reduction is incurred at a loss of the spatial resolution in the direction. The invention disclosed allows dose reduction without loss in spatial resolution.

Even assuming, *arguendo*, that all of the elements of claims 2, 10, 18 and 26 may be found within various passages of Morgan, Casey, Yamagishi and Taguchi, it does not appear that the Examiner has presented sufficient objective evidence of the requisite reasoned basis to combine these references. Specifically, the Examiner has not presented sufficient objective evidence as to why one skilled in the art would have been motivated to *generate a set of interpolated projections by interpolating the projection data set using* phase information from the projection data itself *or from a set of concurrently acquired phase data and apriori frequency content of the projection data set, wherein each interpolated projection characterizes the projection data set at a particular view location of the gantry and at a particular time; and reconstructing the set of interpolated projections to generate one or more images.* For instance, the only reference, which discloses *interpolated projection* that *characterizes the projection data set at a view location of the gantry and at a particular time* is Yamagishi. However, the

interpolation that Yamagishi describes is the standard interpolation processes known in the art of image reconstruction for projections of a volume. There is no discussion either in Morgan or in Casey regarding combining *interpolated projection* that *characterizes the projection data set at a particular view location of the gantry and at a particular time; and reconstructing the set of interpolated projections to generate one or more images.* Conversely, both Morgan and Casey, at most, merely disclose the specific scenarios of combining multiple fan beam computed tomography system with gantry position reference for tomographic scanners respectively. Neither reference appears to suggest that the other scenario of *interpolated projection* that *characterizes the projection data set at a particular view location of the gantry and at a particular time* is contemplated, much less desirable. Therefore, none of the references appear to supply any motivation or any other reasonable basis for combination with the other references.

Rather, it appears the Examiner has merely used to Applicants' presently canceled claims 2, 10, 18 and 26 as a roadmap to find three disparate references that may, when hypothetically combined, disclose individual aspects of the recited subject matter. In other words, Applicants contend that the Examiner has used "hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention," as explicitly forbidden by well-established case law. *See In re Fine*, 837 F.2d at 1075; 5 U.S.P.Q.2d at 1600. Therefore, Applicants respectfully submit that this type of combination does not meet the required standard of evidence or satisfy the requirements of *prima facie* obviousness.

Notwithstanding these proclamations regarding predictable results and proposed benefits of the hypothetical combination of the cited references, Applicants contend that there must also be some likelihood of success of such hypothetical combination. However, in this case, Applicants contend that no likelihood of success exists regarding the hypothetical combination of the cited references. In particular, the cited references appear to be structurally and functionally incompatible and, therefore, could not be combined with each other. In other words, if even possible, any one these three systems would need to be substantially restructured or reconfigured to combine the functionality of, not only *interpolated projection* that *characterizes the projection data set at a particular view location of the gantry and at a particular time* but also *reconstructing the set of interpolated projections to generate one or more time-resolved images.* For example, the CT scanner of Morgan that includes a stationary gantry and a rotating gantry is structurally and functionally considerably different than Casey's CT apparatus that includes a gantry for moving about an axis through a plurality of angles. These two systems are further removed from the Helical Scanning type X-Ray CT imaging system of

Yamagishi.

In summary, neither Morgan nor Casey nor Yamagishi nor Taguchi suggests or teaches or discloses the elements as recited in independent claims 1, 9, 17 and 25. Claims 3-7, 11-15, 19-23, and 27-29 depend directly or indirectly from claims 1, 9, and 17 respectively. Accordingly, the Applicants submit that claims 3-7, 11-15, 19-23, and 27-28 are allowable by virtue of their dependency from allowable base claims. Thus, it is respectfully requested that the rejections of claims 1, 3-7, 9, 11-15, 17, 19-23, and 25 under 35 U.S.C. §103(a) be withdrawn.

Summary

For the reasons set out above, Applicant respectfully submits that the application is in condition for allowance. Favorable reconsideration and allowance of the application are, therefore, respectfully requested.

If the Examiner believes that anything further is necessary to place the application in better condition for allowance, the Examiner is kindly asked to contact Applicant's undersigned representative at the telephone number below. **Telephone interviews are strongly encouraged by the Applicant to expedite prosecution.**

Respectfully submitted,

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